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AIRCRAFT ARMAMENTS, Inc.
COCKEYSVILLE, MARYLAND

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ENGINEERING PROGRESS REPORT
E41R1 POINT SOURCE GAS ALARM
Contract Number
DA-18-108-CWL-6553
for

ARMY CHEMICAL CENTER
Edgewood, Maryland

for
Period of June 11, 1961

Through July 22, 1961

ER-2473
REPORT NO.

Aug. 1961
DATE

Prepared by: Edward B. [signature]
Date

Approved by: C. B. [signature] 8-31-61
Date

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AAINC E135A

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I. INTRODUCTION

This report describes the engineering progress of AAI from 11 June thru 22 July 1961 under Contract II DA-18-108-CWL-6553 on the E41R1 Point Source Gas Alarm. Included herein is a summary of the combined effort development with CRDL for the design and fabrication of the E41R1 alarm and associated equipment.

During this period the scope of effort has been modified with emphasis on the retrofitting of three (3) alarms (#17-19-22) and the manufacture of three (3) new alarms (#35-36-37) to replace the ones now undergoing Service tests at Fort Benning.

Procurement and fabrication of components for six (6) additional alarms is now in progress. These six (6) alarms will reflect changes as determined by the Final Engineering Test Division, CRDL, Research and Development Testing at AAI and Service tests conducted at Fort Benning, Georgia. An additional fifteen (15) alarms are to be built, and one Master Alarm is to be constructed in accordance with the Class I drawings.

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II. SUMMARY OF WORK PERFORMED

The Research, Development, Test and Evaluation program for the E4lRl Point Source Gas Alarm has progressed as scheduled during this report period. AAI and CRDL are conducting a coordinated test program directed toward improvement of alarm performance and reliability.

CONARC tests are continuing at Fort Benning, with engineering personnel from CRDL and AAI participating.

Continued efforts in Research, Development, Test and Evaluation have been effected in the following areas.

a. Testing of original and experimental design air pumps.

b. Investigation of improved alarm horn performance and reliability.

c. Investigation of improved performance and reliability in the case heater thermostats.

d. Continuing efforts to improve the sensitivity and stability of the photometer.

e. Testing of new configurations of the fluid pump.

f. Investigations leading to a more reliable vacuum sensor switch.

g. A continuing program of investigations into the degradation of materials.

h. Maintenance and design evaluation by human factors personnel.

III. DETAILED DISCUSSION OF PROGRESS

A. Phase II Program

1. Class I Drawings

During this period, action has been initiated on the final updating of all Class I drawings.

2. The retrofitting of alarms #17-19-22 were completed and fabrication of alarms #35-36-37 is now in progress in accordance with AAI drawing 3862-040299-10. This drawing is consistent with the Phase II Class II drawings which have been submitted to CRDL. These units will incorporate the following major changes.

a. High-torque solution pump motor and high-torque tape transport motor.

b. New inlet air heater

c. Improved air exit heater

d. Improved tape transport assembly, including a new machined photometer head and drum drop latching mechanism

e. Ball bearing replacing nylatron bearings on the fluid pump assembly

f. New pre-filter lever and lever mount

g. Liquid nozzle positioning spring and stop

h. New type waterproof phone jack

i. "D" rings

j. Improved scotch-cals

k. Fluid pot guide

l. Air inlet open lock and seal provided between the core and inlet housing.

m.. External primer-knob mounting waterproofed

n. Redesign of adjust knob by incorporating limit stops

o. Redesigned horn assembly

p. Circuit modifications including transport motor control, heater control, low voltage cut-off, RFI suppression, etc.

q. Improved waterproofing

r. Improved design for dust caps and chains

B. Phase III Program

1. Class I Drawings

Action has been initiated on the final updating of all Phase III Class I drawings. These drawings shall reflect information derived from the field test program and the in-house research and development programs.

2. The procurement of material, fabrication of parts and assembly where possible, has commenced on the six (6) alarms which are scheduled for delivery in August 1961. To date this program is on schedule.

C. Research and Development Program

1. Air Pump Assembly

In accordance with the coordinated AAI/CRDL test plan, bench testing of the air pumps has continued on a 24 hour basis. As stated in previous reports, two types are undergoing evaluation:

a. The standard pump configuration except that the distance between the motor mount and pump shaft has been decreased

b. An experimental configuration wherein the valving is 90° to the pump action.

The pumps were disassembled at the start of this test and weighed at the end of each 100 hour period of operation; the pumps were again disassembled and weighed. During the first 500 hours of operation, filters furnished by CRDL were used in the air line between the bubbler containing 6_{mg} ODN solution and the air pump. These filters were changed every 12 hours. The last 400 hours of operation have been run without filters. There has been no significant difference in the accumulation of deposits.

As of the end of this reporting period the standard pump had been operated 934 hours (920 hours on the air motor) and the experimental configuration has been operated 784 hours (764 hours on the motor).

STANDARD PUMP

PART	WEIGHT - GRAMS ORIGINAL	500 hours w/FILTERS	400 hours w/o FILTERS	CHANGE	PERCENT
DIAPHRAGM	1.0161	1.0171	1.0223	.0062	.006
INLET FITTING	1.0131	1.0180	1.0222	.0091	.009
EXHAUST FITTING	1.2940	1.2979	1.3187	.0247	.019
INLET VALVE	0.1679	0.1678	0.1693	.0014	.009
EXHAUST VALVE	0.1684	0.1699	0.1739	.0055	.031

	WEIGHT - GRAMS ORIGINAL	300 hours w/FILTERS	400 hours w/o FILTERS	CHANGE	PERCENT
DIAPHRAGM	1.0279	1.0282	1.0296	.0017	.002
INLET FITTING	0.9522	0.9519	0.9560	.0038	.004
EXHAUST FITTING	0.6917	0.6902	0.6996	.0079	.022
INLET VALVE	0.1646	0.1662	0.1659	.0013	.008
EXHAUST VALVE	0.1667	0.1667	0.1673	.0006	.004

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Two air pump motors which failed recently have been forwarded to Globe. Upon their evaluation as to the cause of the failure, a formal analysis will be proposed and submitted to AAI. AAI's preliminary investigation indicates the failures may be due to a breakdown in the motor lubricants after being subjected to high temperature operations.

Even though these failures are of an isolated nature, AAI has been making inquiries to various companies concerning the availability of motors suitable for use with the air pump. If available, this motor would be used as a back-up and/or replacement for the present Globe motor. The A.W. Hayden Company has stated that they have a "shelf item" which will meet the required life expectancy and, as proof thereof, have offered to conduct the necessary endurance testing (at no cost to AAI). Therefore, a pump assembly has been supplied and an air motor specification is being prepared which will be forwarded to the A.W. Hayden Company. It is anticipated that testing will commence on or about 1 August 1961.

2. Electronics

During this reporting period representation of CRDL and AAI visited Edwards Company to witness final testing of a new horn assembly. These horns (for the replacement Ft. Benning alarms) were fabricated using a fiberglas diaphragm with a copper plating on the underside (for RF suppression). Other changes included a redesign of the pole pieces and packaging in a waterproof can. The horns were subjected to the following tests.

a. Temperature.- Two assemblies were packed in dry ice until thoroughly chilled after which they were operated satisfactorily without

any apparent degradation in sound level. They were then immediately placed under a sun lamp and after several minutes, again operated satisfactorily. However, a visual inspection revealed a separation between the plating and the diaphragm and in warping of the diaphragm, both of which were attributed to thermal shock. In confirmation, new diaphragms were installed and the horns were operated over a range of -100°F. to +200°F. Performance was satisfactory, however, the transition over this temperature range was gradual.

b. Case Mounting.- A horn was installed in a new case recently obtained from Atkins and Merrill. Upon proper tightening of the mounting screws the recorded sound level was 82db and was clearly audible at 200 yards over an ambient noise level of 50-55db.

c. Waterproofing.- A canned horn was submerged in one foot of H_2O for 20 minutes and periodically sounded. Upon removal from the H_2O and disassembly, moisture was found in the can interior. This accumulation was disregarded since the unit had not undergone a complete waterproofing, however, the waterproof capability had been reasonably indicated.

Four of these horn assemblies were retained - one by CRDL and three by AAI. Similar testing to that above was conducted at AAI with the following discrepancies noted:

(1) An inferior grade of hardware was used in mounting the horn can assembly to the adapter ring.

(2) After less than 40 hours of operation a rust accumulation was noted on the adjusting screw.

(3) A lack of rust preventative on other hardware and components.

(4) No protective finish on the horn can (internal or external) and no finish on the adapter ring.

As a result of these discrepancies, a rigid specification control drawing has been prepared and forwarded to the Edwards Company for a formal price quotation and delivery schedule. However, due to alarm delivery committments the three horns mentioned herein have been installed in units 35, 36 and 37. It is anticipated that any future alarm will be equipped with horns fabricated in accordance with the specification control discussed.

An investigation into the periodic problem of the 36° and 42° case heater thermostats operating in reverse sequence was undertaken. After testing in a cold box environment, it was concluded that a 2-4°F. differential exists between the location of the two thermostats. It was further concluded that some heat is generated in the timing motor windings which is inherently transferred to the mounting plate. This heat travels toward the hinged end of the plate with the effect of moving the operating points of the 36° and 42° thermostats together by the amount of the temperature differential. The result was causing the 36° thermostat to act prematurely with respect to the 42° thermostat. In correcting the above situation, the physical locations of the thermostats have been reversed.

In addition to the above the Klixon Company has been contacted with regard to heavier duty (5 amp) thermostats for use as a back-up and/or replacement for the Fenwall thermostats now in use. Two pairs of sample thermostats are being forwarded and it is anticipated that AAI will commence testing on or about 1 August 1961.

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For the purpose of checking uniformity among a sample batch of Clarex 605L photocells a test rig has been built in the AAI laboratory. It is anticipated that data obtained will reveal the differences between photocells subjected to equal conditions of light level, current and temperature. In addition, the effects of temperature changes on the photocell will be studied. When the extent of temperature effects are known, attempts will be made at devising means to offset these effects through the use of compensating components or bridge circuits.

In using this test rig, the photocells are biased and are illuminated by a bank of lights to the approximate operating point of the photocells currently used in the alarm photometer head. A stepping switch automatically samples the output of each cell in sequence and the output is recorded on a Rustrac chart. It is expected that this simultaneous lifetime testing of 12 type 605L photocell will provide the data necessary to evaluate the above slated objectives.

A new photometer head configuration has been devised which employs two photocells in a bridge circuit. It is considered that this design will provide self-compensation for temperature drift inherent in the photometer.

In the present circuit, this drift is registered on a meter relay; in the bridge circuit the two photocells similarly drifting with temperature will maintain the bridge in balance and hence, not be indicated on the meter relay.

The first head of this type has been built and installed in Alarm #9. The head thus far appears to be accomplishing its purpose; however,

when subjected to a GB gas sensitivity test, a relatively poor response was attained. Factors contributing to this poor response are:

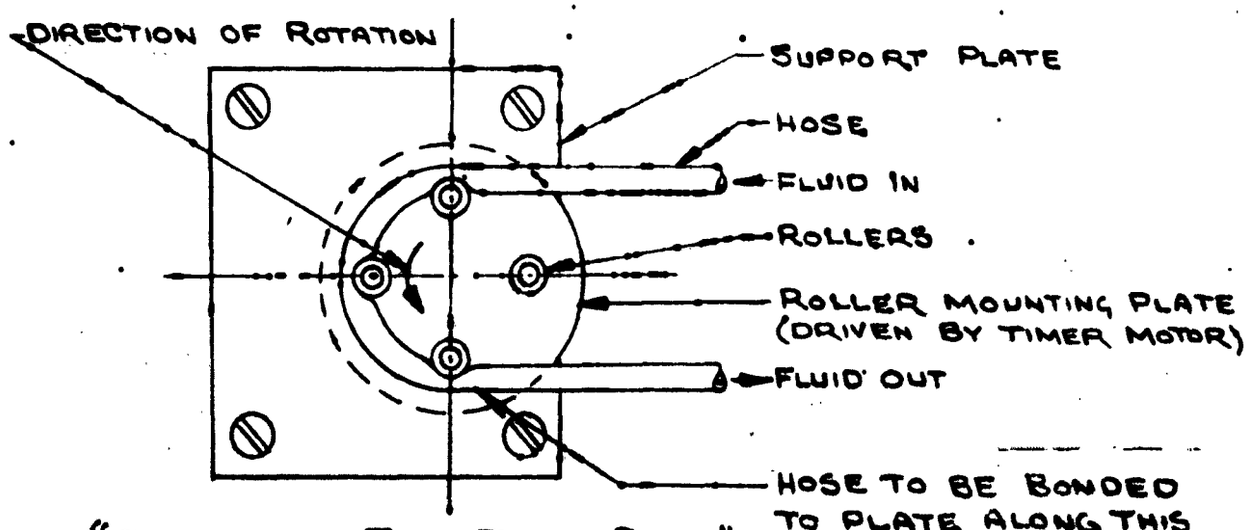
a. The photometer head was fabricated by laboratory personnel and was made from parts salvaged from existing heads.

b. The scale of the meter relay readily available required a large current for full-scale deflection (±100μa). A more desirable meter scale would be ±25μa.

The detection portion of this head is unchanged from those currently in use, consequently no degradation in sensitivity is expected with properly fabricated units. Three new heads are in the process of manufacturing and on completion will be used in a continuing program of development and evaluation.

3. Fluid Pump

New hose samples were tested in the four (4) roller supported tube configuration at room temperature and at 140°F. The displacement remained constant at .5 ml/cycle. The pump must now be modified to reduce this flow to a useable value. This configuration is as shown below:



"SUPPORTED TUBE FLUID PUMP"

AAINC E1324

Design studies have been conducted using a positive displacement piston arrangement in addition to the "paddle" design as previously discussed with CRDL personnel. A prototype model has been constructed by AAI Model Shop but no testing has been done due to the urgency of the June alarms (#17 - 19 - 22) and the new Ft. Benning alarms (#35 - 36 - 37) plus a general reduction in the R&D effort.

4. Documentation

The previous Progress Report (ER-2431) stated that it was anticipated the three (3) purchase descriptions prepared under Phase II of the initial subject contract would be rewritten to incorporate the necessary changes to conform to the Phase III alarms, remote warning units, and chemical resupply kits. This anticipation has been revised and only two (2) purchase descriptions are now anticipated to be rewritten. The chemical resupply kit purchase description has been deleted. The two (2) purchase descriptions anticipated for rewriting are numbered as: 197-54-796 (Alarm, G-Agent, Automatic, Field, E41R1) and 197-54-797 (Remote Warning Unit, for use with E41R1). These purchase descriptions will be written in accordance with the provisions of Standardization Manual M205 and Notices 1 through 5 of the CmlC Instructions for the Preparation of Specification Draft, dated 17 May 1960, and the Mechanical Specification Format. Section 5 of each of these purchase descriptions is to be supplied by the Chemical Corps. Ten (10) copies of the reproducibles of each of the purchase descriptions will be delivered.

Errata sheets for the "Operator's and Organizational Maintenance Manual (ITM 3-6665-210-12) have been received from CRDL. These changes

have been reviewed by AAI personnel and the changes are being incorporated in the new manuals scheduled for delivery with the Ft. Benning alarms. In addition, other changes are being included in this manual which will reflect all changes that have been made on these alarms up to the time of publication.

5. Impact Studies

All scheduled impact testing has been completed by AAI. The fluid pot area has been modified and successfully drop tested. The tape drum latch down mechanism has also been modified and successfully drop tested.

The impact test rig used by AAI has been loaned to CRDL. The drum latch mechanism, designed and fabricated by CRDL personnel, is to be installed on this rig and returned to AAI for impact testing.

6. Vacuum Sensor Switch (Baro)

AAI fabricated and installed baro switches in alarms #15 and #27 on June 21, 1961. These alarms were then returned to the endurance test at CRDL. Difficulty was encountered in the baro switches functioning effectively. An excessive number of malfunctions occurred that were due to the baro switches rather than the alarm performance. The switches were readjusted so that eventually they were completely ineffective.

New baro switches were also installed on the retrofitted alarms (#17 - 19 - 22). Alarms #17 and #22 were delivered to CRDL on July 14, 1961. These alarms do not have sufficient running time, at this point, to properly evaluate the baro switch performance.

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As a result of the difficulties experienced by AAI and CRDL with the effectiveness of the baro switches, it has been decided that the baro switch will not be installed in alarms #35 - 36 - 37. The search to find a pressure sensing device that will function properly and effectively in the E41R1 Point Source Alarm is being continued because it is still felt that this is a very desirable feature.

7. Applied Chemistry

There have been several recent instances where alarm parts manufactured from Nylatron and Nylon have been a contributing factor to alarm failures. These parts, probably due to high temperature and high humidity, have a tendency to swell due to moisture absorption and/or deform, i.e., the bearing for the timing motor (swelling); the air intake support collar (deforming).

Therefore a study has been instigated to determine the deterioration of components due to moisture absorption. Thus, various pieces of selected plastic materials have been undergoing water submersion. The results are as follows.

DATE	TEMP	NYLATRON	NYLON	DELRIN	DIALLY PHTHALATE
5/16/61	Room	3.6307	--	--	--
5/18/61	Room	3.6604	--	--	--
5/23/61	Room	3.6754	2.2849	--	--
5/26/61	Room	3.6837	2.2933	--	--
6/ 7/61	+115°F.	3.7182	2.3038	5.5116	--
6/16/61	+115°F.	3.8117	2.3422	5.5431	14.3332
6/26/61	+115°F.	3.8353	2.3661	5.5615	14.3370
7/ 6/61	Room	3.8446	2.3803	5.5646	14.3808
8/ 7/61	Room	3.8546	2.3891	5.5898	14.3881

AAINC 8184

As indicated in the previous report, a conference was convened with representatives of CRDL, Atkins and Merrill, Inc., Isocyanate Products, Inc., American Cellular Products, and AAI to discuss the problem associated with alarm case swelling. After presentation of the problem and considerable discussion, probable causes were suggested to be:

a. Residual cleaning - solvent vapors acting on the foam at elevated temperatures

b. A chemical component of the adhesive exerting the same type of action

c. Possible thermal relieving of stresses in the laminated fibreglas.

Corrective action for future units includes substitution of inert solvent for cleaning, use of different adhesive not affecting the foam, change in case design or fabrication techniques and substitution of materials of a more resistant nature. However, it should be noted that the alarms being fabricated in accordance with the present contract will not contain these corrective actions since these alarm cases were considered long lead items; thus, they have been delivered to AAI prior to this reported meeting.

8. Photometer Head

A continuing program of studies has been maintained to determine if the photometer as used in the alarm could be increased in sensitivity and also could be stabilized for temperature changes. Components have been selected, test photometer units assembled, and tested individually.

In addition, these heads have been mounted on a test panel and are now being simultaneously subjected to temperature variations, and these variations plotted for comparison purposes. These heads are being tested in the following configurations.

a. A standard alarm type using a 602 photocell

b. A redesigned head with the 605L photocell and the exciter lamp mounted in the head

c. A new head with the 605L photocell and the exciter lamp mounted externally.

A photometer head as described in 6 above has been placed in an alarm and is undergoing tests under actual environmental conditions. This head has not performed as well as the CRDL "Model A" head, therefore, the photocell "gang" test was initiated (see section II. Electronics Testing) so as to determine exact photocell performance with all variables isolated. In addition, other approaches are being considered but which will involve substantial changes to the present photometer configuration. Such studies are bridge circuits with and without the photocell exposed to the exciter lamp, differential amplifier and automatic swelling.

An RCA 6694A CdS mono-crystalline photocell was subjected to tests to determine the cell's stability in changing temperature and the cell's sensitivity to gas when used in an alarm. The stability tests were conducted using a 12 volt lamp and the photocell. These tests indicate that the photocell is very stable in the temperature range of 30°F. to 150°F. with a maximum of 5.4% change in resistance from room temperature values.

The photocell is also able to stabilize within 15 minutes after a change of 120°F. in ambient temperature, and returned to 1% of its original value when returned to room temperature.

In the sensitivity tests the alarm null point was set at 90 μamps vs 100 μamps due to the high resistance of the photocell and the limited light level available. These tests showed an average of 6.0 μamp drop for a concentration of 0.6 ✓ and a CT of 0.5. Air blank caused a drop of approximately 2.0 μamp.

On 21 July a meeting was convened at AAI with representatives of AAI and CRDL in attendance. The areas discussed included the "Model A" head, automatic nulling, photometer bridge, photocell tests, outside consultation, cleaning and maintenance problems. It was agreed that when a quantity of the "Model A" heads become available, AAI would install them in alarms #9 and #22 and conduct eight (8) hour/day test and 24 hour/day tests respectively. CRDL would do the same testing using alarms #13 - 15 - 16 - 18.

9. Radio Noise Suppression

Alarm #30 was modified for radio noise suppression and on June 14, 1961 a test was performed at CRDL to determine the effectiveness of the suppression measures. A Hallicrafter SX-62 receiver was used for the test. The range in which interference was looked for was from 550 kc to 108 mc. The human ear was used to determine the degree of interference. When the alarm was operating normally interference was noted from 46 to 55 mc and from 72 to 85 mc of the FM band. This interference was of a crackling

nature. No interference could be noted when an alarm condition (horn blowing) existed. A walkie-talkie (SPRC-9) and a handi-talkie (Unit #39 Motorola FM radiophone) were also checked for interference. No interference was noted when these units were used for sending or for receiving. This unit (Alarm #30) was returned to AAI for further investigation of radio suppression.

AAI removed the Brailsford transport motor and installed a Hayden Motor, since the Hayden motor would be used in future alarms. It was noted that the air pump motor suppression had been improperly installed. This was corrected. A test was run at AAI to determine the effectiveness of the rework. The unit was checked using a Hallicrafter SX-62 receiver from .54 to 32 mc (AM) and from 26.6 to 110 mc (FM) under normal operation, an alarm condition (with horn and flasher circuit and without horn but with flasher circuit), and during continuous transport. No interference was noted. The unit (Alarm #30) was returned to CRDL for retesting.

On July 6, 1961 the same test that was run on June 14, 1961 was repeated. Interference was noted in the 42 to 54 mc range. This noise could be distinguished as being the operation of the air pump motor. When the AM antennae was removed from the Hallicrafter SX-62 receiver, the noise ceased. Also, when the alarm was moved about 5 feet away from the receiver the noise ceased. Alarm #30 was returned to AAI at the termination of this test.

An investigation was performed to determine the effects of RF suppression measures upon the alarm delay circuit. This investigation was undertaken because of a report from Ft. Benning that there is a tendency for an alarm with RF shielding and suppression to give an alarm indication

after transport. After a thorough investigation, it was concluded that the suppression measures do not adversely affect the delay circuit or cause any deterioration. It was further concluded that the probable cause of the alarming in the unit at Ft. Benning was an open diode in the delay circuit. Of four units checked at AAI during this investigation, two were found to have this particular diode open. The investigation revealed that there is no indication of inherent circuit defects due to design that would tend to damage these diodes.

10. Human Factors Evaluation

AAI's human factor personnel have evaluated the drum latch mechanism. Initially it was reported as satisfactory, but after studying this mechanism in alarm #22, the report was revised. The revision stated that while this design simplicity would be satisfactory for field use, consideration should be given to a latch that would embody similar simplicity but that would require less operator force.

An analysis has been completed by an AAI's human factor engineer which covers all aspects of maintainability from operating instructions to component location. (Pending availability of finding, this report shall be formally reviewed by personnel of AAI and CRDL.)

11. Endurance Testing

Three (3) alarms, #13 - 15 - 27 (CRDL) and one (1) alarm, #11 (AAI) are undergoing endurance testing on a 24 hour basis. These units are being subjected to controlled temperatures ranging from -40°F. to +115°F.

and, in addition, at times are run out of doors to more closely duplicate the conditions prevalent during the Ft. Benning service test.

These tests are providing useful data on the operation of the tape transport system, control switching, transport motor circuitry, fluid pump stability, air pump performance, operation of the photometer head and overall stability of the units. Periodic sensitivity tests are being conducted to assure proper operation under all conditions.

In addition to those alarms undergoing endurance testing, other alarms are being operated on other aspects of the research and development program. The total time for all alarms (as computed from available records) is as follows:

ALARM TOTAL TIME

ALARM	AAI	CRDL	TOTAL	ALARM	AAI	CRDL	TOTAL
9	1049	--	1049	22	160	181	341
11	387	269	656	*22	184	--	
12	150	36	186	23	78	744	822
13	141	736	877	24	36	--	36
14	149	18	167	25	36	--	36
15	333	885	1218	26	161	24	185
16	105	109	214	27	159	878	1037
17	576	--	576	28	36	248	284
*17	87	--	87	29	165	36	201
18	88	66	154	30	602	--	602
19	33	--	33	31	166	24	190
*19	176	--	176	32	36	6	42
20	140	36	176	33	69	261	330
21	117	24	141	34	36	--	36

* Total time after refurbishing

12. Fabrication and Testing

Of the three (3) units (#17 - 19 - 22) which were refurbished by AAI during this period, units #17 and #22 were delivered to CRDL on

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July 17, 1961. Unit #19 was retained at AAI for use in development testing. Prior to delivery these units underwent the following acceptance testing.

Test #1	12 hours	Room Temp	24 V
2	12 "	+115°F.	24 V
3	12 "	-40°F.	24 V
4	12 "	Room Temp	21-28 V changed ea. 2 hrs.
5	3 "	Room Temp	21-24-28 V changed hourly
	3 "	-40°F.	21-24-28 V " "
	3 "	Room Temp	21-24-28 V " "
	3 "	+115°F.	21-24-28 V " "
6	12 "	Outdoors	Battery
7	12 "	Outdoors	Battery
8	12 "	Room Temp	24 V

At the conclusion of the above tests, the units were subjected to the air pressure tests on the fixture supplied by CRDL. Each alarm successfully passed the prescribed requirements, i.e., equal air flow at the inlet and outlet at 2" Hg vacuum. Actual alarm performance varied from .5 l/m air flow at 4" Hg to .9 l/m air flow at 4" Hg. Prior to the pressure test the alarms were submerged under 2 feet of water. Leakage was experienced in the outer cavity and at the external primer. The top panel components were resealed, the primer modified, and the alarms subjected to the pressure test with the above results. The alarms were again submerged for two hours each and no leakage was detected.

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Testing has been inaugurated on the three alarms which will be delivered to Ft. Benning, Georgia (alarm #35 - 36 - 37). The test plan to be followed is a result of a coordinated effort of CRDL and AAI personnel. The test description follows.

Test #	Test Cycle		Test Description	Location
1	A		Debugging - Cycling - 3 hrs. each; Room - +115°F, -40°F., Vary Voltage(21-24-28)	AAI
1A	B		Adjust, Repair and Repeat Test #1, if necessary	AAI
2	A		Bench Test; Room Temp with Battery	AAI
3	B		Oven Test; +115°F. with Battery	AAI
4	A		Bench Test; Room Temp, Vary Voltage in 2 hr. steps (21-28V)	AAI
5	B		Oven Test; +115°F., Vary Voltage in 2 hr. steps (21-28V)	AAI
6	A		Outdoor Test with Battery	AAI
7	B		Outdoor Test with Battery	AAI
8	A	*	Sensitivity	CRDL
9	B		Tropical Test; 100°F, 85% R.H., Battery	CRDL
10	A		Road Test; (2) on Battery Power, (1) on Vehicle Power	CRDL
11	B		Shower, air pressure RF1	CRDL
12	A	*	Sensitivity	CRDL
13	B		Tropical Test; 100°F, 85% R.H., Battery	CRDL
14	A		Cold Chamber; -40°F, Battery	CRDL
15	B		Clean-up	AAI
16	A		Final Checkout and Test	AAI
			Delivery and Meeting	CRDL

* Min. Detectable, 1 and Sniff Bottle using GA, GB and "A" Aerosol @ 24V.

AAINC E1384

D. Fort Benning Service Test Program

1. This program was officially started at 1000 on April 27, 1961 and is continuing on a 24 hour/day, 5 day/week schedule. The following is a summary of Equipment Failure Reports and the corrective action anticipated on the future CONARC Test Models.

EFR #	DESCRIPTION	CORRECTIVE ACTION
1, 12	Timer Motor Gear Train Failure	High Torque motor with improved gear train
2	Ruptured air pump diaphragm	Cause of failure unknown - may have been random failure or an early type diaphragm
3,5,6	Condensation on meter relay	More effective waterproofing of alarms, waterproof all top panel wire connections
4	Timer motor - intermittent operation	Replaced nylatron bearings with ball bearings
7,8	Prefilter lever support failure	Changed material from nylatron to aluminum, modified lever design to facilitate installation
9	Horn - Failure to sound	Redesigned horn to maintain sound level of 85-90 db. Added waterproof can. Fabricated diaphragm of fiberglas for improved high and low temperature performance. Added external horn adjustment
10	Voltage Regulator drift	Exact cause of failure unknown. To improve regulator drift characteristics only slightly would require additional components equal in volume to existing printed circuit board. Further action not advisable
11	Drum transport spring fatigue	New stainless steel material used which has substantially improved fatigue characteristics
13	Drum transport system failure	Redesigned Mechanism: replaced nylatron pivot bearing with pair of ball bearings; displaced drum 1/16" outboard from plate; improved pivot plate guide; bored nylon drum and added rulon bearing insert; improved drum

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EFR #	DESCRIPTION	CORRECTIVE ACTION
13, cont'd		latch; provided for complete interchangeability of photometer heads
14	Low Voltage cutoff drift	Redesigned section of PCB to improve stability characteristics. Testing over range of 25°F. 150°F. produced a total change of .3 V.
15	Battery Deficiencies and Correction	
	a. Handles break at welded joint	Improved inspection of welded joint
	b. Loss of capacity during short term storage	Cause of this capacity loss was found to be leakage paths created by electrolyte leaking from cell vents. Vents have been modified to effect an improved seal.
16.	Photometer drift	It is recognized that the existing photometer head is relatively unstable at high temperature. Since new type replacements have not been completely tested, it would be unwise to install a new type at this time. The existing head will provide adequate service providing proper maintenance procedures are followed which may include but not be limited to such actions as scheduled periodic disassembly and cleaning and readjustment of meter setting, after initial hour's operation, if necessary. It should be noted that any new head will be interchangeable with that presently used in the alarm.

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IV. FUTURE IMPROVEMENT CONSIDERATIONS

Concurrent with the research and development tasks outlined herein, evaluations will be made to determine those areas where improvement in the performance and reliability of component parts may be accomplished. It is further planned that a comprehensive evaluation of the complete E41R1 Point Source Gas Alarm will be undertaken.